The territorialization of the energy transition in Switzerland: reconfiguration of current production and distribution patterns

Thierry Theurillat – Western Switzerland Applied Sciences University (HES-SO), HEG Arc, Neuchâtel, Switzerland

Ariane Huguenin – Group of Research in Territorial Economy, University of Neuchâtel, Switzerland

Milena Properzi - Western Switzerland Applied Sciences University (HES-SO), HEG Arc, Neuchâtel, Switzerland. University of Applied Sciences of Southern Switzerland (SUPSI), DTI, Switzerland

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Abstract

This articles deals with the energy transition and the local production of renewable electricity in Switzerland. It first develops an institutionalist and territorial analytical framework based on two main stylized models of electricity production. The first model relates to the export base theory where energy locally produced is sold outside the region. This model implies a national and vertical organization where energy is produced by a few producers and distributed through local energy suppliers to consumers. This fordist system characterizes the institutional framework of the value chain of the nuclear and fossil power electricity based on economies of scale that has been implemented world-wide these last 50 years. The second model relates to a colocation of electricity production and consumption, and consequently implies a new fit between the institutional framework and the economic value of local energy. We posit that this post-fordist system tends to characterize the production of renewable energy that is politically supported in Switzerland and whose economic profitability is embedded in sociocultural values. Based on a local energy transition case study, the second part of the article highlights the reconfiguration of current production and distribution patterns. It first shows that the evolution of local energy supplier business models is strongly connected with national and local policy financial incentives. Second, it shows that the construction of the value of the local photovoltaic solar market has implied the emergence of a local valuation milieu, made up of the municipality, the local energy company and local Ra&D institutions.

Key words : Energy transition, renewable electricity, institutions, territorial development, local energy supplier and producer

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Introduction

Energy and climate policies in Switzerland are based on the new energy strategy 2050 that came into force this year. While its elaboration has been based on two main existing programs since 2009, related to energy efficiency and energy transition, it was decided to abandon nuclear energy by 2050. In Germany the same decision to phase out nuclear power has gone in hand with massive investment to develop renewable energy (wind and solar power) both based on large-scale and centrally produced electricity and decentralization in regions and cities (Dewald and Truffer, 2012)– which has then implied to re-develop coal-fire electricity though. In Switzerland, the expected energy transition through renewable energy is mainly based on a rather large decentralization of production. Moreover, the hydropower electricity is quite well-developed in Switzerland, and the photovoltaic solar energy basically represents the main potential for this decentralization of renewable electricity production (Energy Strategy 2050). Finally, since space is quite scarce in Switzerland, photovoltaic solar production implies an integration of cells into the built environment which goes in hand with rather quite micro-installations.

The energy transition at the local scale, often based on solar energy production and new business models for local and regional utilities, has been increasingly documented by scholars these last years (Schoettl and Lehmann-Ortega, 2010 ; Richter, 2012; 2013; Huijben and Verbong, 2013; Klagge and Brocke, 2015; Engelken et al., 2016). Further developing from three main fields of transitions literature originated at the intersection of evolutionary economics and constructivist approaches in studies of technology and science (STS), such as the technological innovation system (TIS), the multi-level perspective (MLP) and strategic niche management (SNM), the subfield of the geography of sustainability transitions has emerged these last years (Hansen and Coenen, 2015). This emerging field emphasizes the role played by the "local" in implementing the energy transition, and consequently the variegation resulting from it across places. Shortly said, it first embeds sociotechnical characteristics for transition within its specific institutional multi-scale framework as well as the multi-actors involved in energy transition. It also embeds the "local" in relation to the outside and other places at various scales.

This articles deals with the energy transition and the local production of renewable electricity in Switzerland. It first develops an institutionalist and territorial analytical framework that addresses the construction of the local market of renewable energy by connecting the geography of sustainability transitions with the urban and regional development literature. Two stylized models of electricity generation both from the perspective of production and consumption are highlighted. The first model relates to the export base theory where energy locally produced is sold outside the region for a non-identified demand. This model implies a national and vertical organization where energy is produced by a few producers and distributed through local energy suppliers to consumers. This fordist system characterizes the institutional framework of the value chain of the nuclear and fossil power electricity based on economies of scale that has been implemented

world-wide these last 50 years. In contrast to exportation, the second model relates to a colocation of electricity production and consumption, and consequently implies a new fit between the institutional framework and the economic value of "local green energy". Thus, the construction of the local market must be viewed as a re-territorialization of electricity which economic profitability has to incorporate socio-cultural values.

Based on a local energy transition case study, the second part of the article highlights the reconfiguration of current production and distribution patterns in the canton of Neuchâtel. It first shows that the evolution of local energy supplier business models is strongly connected with national and local policy financial incentives. Second, it shows that the construction of the value of the local photovoltaic solar market has implied the emergence of a local valuation milieu, made up of the municipality, the local energy company and local Ra&D institutions.

In methodology terms, this article is based on two researches. The first research, achieved between 2012 and 2015, consisted in an in-depth study case of the local energy transitions addressed from the perspective of innovation policy. The second research, made in 2017, was also an in-depth study case from the perspective of the decentralization of renewable electricity production and its impact on the business model of local energy suppliers. Besides documentary analysis, both research results are based on semi-direct interviews with various key actors (public entities, local energy company, R&D managers and companies as prosumers).

1 A territorial approach of the local production of renewable energy/electricity

This section develops a territorial framework to address the issue of energy transition in Switzerland that goes in hand with the increase of local production of renewable energy. It relates the emerging field of "geographies of sustainability transitions" (Hansen and Coenen, 2015) with the urban and regional development literature to highlight two stylized models of energy production to address the issue of the construction of the local market of renewable energy.

1.1 The geographies of sustainability transitions

Based on three main conceptualizations of space in economic geography (which are related to three main "turns"), such as the relational, institutional and evolutionary economic geography, the geographies of sustainability transitions captures the distribution of different transition processes across space. It first highlights the importance of place specificity and the role of local embeddedness in terms of institutions and culture that both structure (having historical path dependency effects) actors' behavior and social relations between actors, but on which actors can act (path creation effect) (Martin, 2010). It second emphasizes the role of spatial relations, within the same place, as well as the multi-scale relations between places and across spaces. As a result,

the geographies of sustainability transitions' field gives an understanding of the varieties of actual existing processes of how and to what extend structural or political agenda phenomena such as sustainability and climate change issues are implemented in various places. Thus, by emphasizing the complexity of transition – in terms of actors, institutions (formal and informal), scales and places – this field extends two main theoretical and socio-constructivist perspectives used in transition studies, such as the "multi-level perspective (MLP)" and the "niche strategic management (SNM)" literatures (Hansen and Coenen, 2015).

First, the MLP perspective gives a three-level view of transitions, which are conceptualized as a structural and one scale (global) shift from one socio-technical regime to another in the technological innovation system (TIS) literature (Geels 2014; Fuenfschilling and Truffer 2014). According to the MLP, shifts arise from the interplay between multi-dimensional developments at three analytical levels: socio-technical niches (micro-level innovation), socio-technical regimes (meso-level institutional rules) and an exogenous landscape (macro-level global trends) (Geels 2002). Made up of various elements that interact (technologies, markets, practices of users, infrastructures, etc.) and resulting from the reproduction of social groups practices over time, dominant regimes are very difficult to change. Niches, at the micro-level, are temporarily protected from the rules of the regime, for instance form the competitiveness-price. They are "spaces" where radical innovations that can breakthrough the dominant regime can emerge. Changes at the macro-level "landscape" based on demographic or environmental changes for instance, are rather autonomous trends which, contrary to the two other levels, are not influenced by regimes or niches. Thus, changes at the regime meso-level are seen as the result of diffusion and extension of niches innovations that are supported by the changes at the landscape macro-level. The MLP gives a useful framework to analyze structural transformations which are initiated by normative objectives at large and global scale and which affect both production and consumption. However, while highlighting the significant role of the niche micro-level for global change, the local space is viewed as an "empty and abstract" space (Smith et al., 2010).

Second, based on the concrete implementation of sustainability norms and objectives, the SNM literature deals with issues related to the ways of driving change (Rotmans et al., 2001; Kemp et al., 2007; Meadowcroft, 2009). Combining short-term objectives based on traditional rationale of current policies with more long-term visions of the future, change implies here a reflexive and participative governance. Experimentation and learning by doing are key characteristics of the implementation of tools and scenario for transition. However, the main focus of the SNM literature is put on the "political actor" as the main actor to manage and implement transition (Huguenin, 2017). Consequently, this approach underrates the actually existing role of the local context, i.e. the specificity and complexity of the relations between the various actors, such as public and private entities and also the civil society, that drive transition from the bottom.

1.2 The local market construction of renewable energy issue

Within the emerging field of geographies of sustainability transitions that highlights the specific role of places or the signification of territorializing sustainability issues, this subsection develops two stylized models out of the urban and regional development literature. These latter provide an understanding of the current energy transition that is viewed as the re-territorialization of economic issues related to both renewable energy production and the local market construction (Hansen and Coenen, 2015). Based on the framework of Guex and Crevoisier, (2017), these territorial stylized facts perspective extends the export base theory as well as related to the economic value creation literature (Table 1). While transition would mean a turn from fordist to post-fordist models of energy production, the actually existing forms of this transition out of these two stylized models are of course variegated.

Table 1 : the two stylized models – fordist and postfordist systems of energy production

	Fordist system	Post-fordist system
Theory	Export base theory	Automous model: import substitution market
Market geographies	Dislocation between production and consumption and national-international market Outside demand non-identified	Co-location of production and consumption and local-regional market Local identified demand
Economic value	Economic value based on price and competitiveness criteria	Economic value that incorporates socio-cultural values (sustainability)
Energy production	Centralization of production: economies of scale and large plants	Decentralization of production: limited economies of scale and rather micro plants
Main actors	Large production companies and large investors	Municipal and regional companies and private local investors (end-users: companies and individuals)
Business model	Classic Sale of cheap and standard-fossil energy	Hybridation of income: production, sale and/or self-consumption of qualified / sustainable energy
Types of policy	Traditional policy based on passive role of state bodies	Innovation and valuation policy: active new role for state bodies

Source : own elaboration

The energy transition as a potential alternative to territorial development based on exportation: Traditional urban and regional development models are implicitly based on the competitiveness paradigm (Porter, 1998; Martin & Simmie, 2008; Segessemann and Crevoisier, 2015). The latter relates to export base theory (Hoyt, 1954) that views development taking place in two sequences. First, cities and regions export manufactured goods within the spatial division of labor. Increasing returns (within companies and the city/region such as agglomeration and

urbanization economies) strengthen export capacity and allow for the generation of revenue. Then, this latter is redistributed, largely to local workers whose expenses induce, in turn, local activities in various sectors; such as consumption, services and investment in real estate. In other words, urbanization is related to elsewhere by production for external demand in the global market while consumption and other related services and real estate make a coherent local system that is induced from the redistribution of revenues. Regulationist/institutionalist and neo-Marxian scholars speak of local accumulation of capital while others profess the Keynesian multiplier effect to analyze the urbanization process from the perspective of the production sector.

In this perspective, the first model we propose relates to the export base theory where energy locally produced is sold outside the region. This model implies a national and vertical organization where energy is produced by a few and large-scale producers as well as investors, and distributed through many local energy suppliers – which can be integrated or not to large-groups – to consumers. This fordist system characterizes the institutional framework of the value chain of the nuclear and fossil power electricity based on economies of scale that has been implemented worldwide these last 50 years. In this dislocation between energy production and consumption, energy is exported at national or international scale, while at the local scale, there has been a natural monopoly for local providers and consequently captive and passive consumers. Here, local markets are not identified in the sense that energy has no specific quality: it is a quite abstract product which production depends on return made out of economies of scales and the economic value of energy is determined by functional criteria based on the quantity of energy yielded. Transactions between the supply side and the demand side of the value chain are essentially based on conventional competitiveness criteria. Prices in this case reflect a mere bargain between two mutually undistinguished and geographically disjoined parties.

Opposite to the export base model, the autonomous or short circuit model relates to activities for which production is not exported (Guex and Crevoisier, 2017). Historically, this is the production that allows the place to be self-sufficient. With the Industrial Revolution and the gradual increase in the spatial division of labor, the market areas for businesses which produce everyday consumer goods have expanded considerably. The industrialization and subsequent globalization movements consisted of a shift in this type towards the export base model. Now, due to the consequences of deindustrialization, and also to environmental pressure, this type of local supply is developing in Western countries by way of an alternative to exports (Rutland & O'Hagan, 2007). The agricultural (Aubry & Kebir, 2013, Deverre & Lamine, 2010), artisanal (Sasaki, 2010) and energy production (Farhangi, 2010 ; Huguenin & Jeannerat, 2017) sectors are especially affected. This last type exists in the post-industrial context, with high mobility of goods, services, and a large spatial division of labor, in a context in which consumers do not only consume local products because they are captives of this place. For example, in the case of food deserts in some urban areas (Gordon et al., 2011; Wrigley, 2002), the captivity of the inhabitants necessitates the

consumption of standardized food produced outside the local space, while local production will be favored in the gentrified districts.

Thus, the second model relates to a colocation of electricity production and consumption. It implies a "post-fordist" model that would substitute the distribution of imported energy to the local production of energy. In this perspective, main key actors would refer to local actors such as municipal and regional utilities companies and private actors. Local actors can have various and hybrid roles, as producers, investors and distributors for municipal and regional energy companies, and as investors or prosumers for end-users like households or firms. The decentralization of production goes in hand with quite limited economies of scale due to rather small installations. However, decentralization could also imply a quite centralized model of energy production on a few of sites. While the production associated with this demand is still generally low, it would have a great potential for quantitative development and, to a certain extent, is only relatively limited by pricing issues. Within this movement to return to a local production–consumption dynamic of energy, insofar as production costs are often uncompetitive, socio-environmental values in particular those associated with the place in question are key. This consequently raises the issue of the creation of the value of the local market of renewable energy.

The creation of the value of local renewable energy: As long as renewable energy remains more expensive to produce than conventional nuclear or fossil energies, then how to incite consumers to pay more for the 'same' product? Re-territorialization is key to understanding the processes at stake in the creation of economic value for renewable energy. In short, this involves three interrelated process. Firstly, re-locating and embedding renewable energy production in the milieu operationalizes the translation (Callon, 1999) of universal aspirations of sustainability into new frontiers and replaces these aspirations into new perspectives. Made visible and tangible for its consumers, energy acquires a new meaning related to the territory of its anchoring thus adding supplementary value to its generation. Energy becomes a 'common pooled resource' (Ostrom et al., 1999), which not only incorporates techno-productive qualities, but which also incorporates 'new' socio-cultural qualities (Aspers and Beckert, 2011; Jeannerat and Kebir, 2016) related to the contexts of its generation. Secondly, the creation and valorization of this 'new quality' strongly relies on the implication of public entities in implementing new kinds of "valuation policy" (Huguenin and Jeannerat, 2017). In supporting the deployment of renewables in the territory, they legitimize the energy suppliers' strategy and more broadly signify their commitment to more sustainable ways of producing and consuming in line with global sustainability transition policy agendas. Thirdly, in engaging in the public demonstration of more sustainable solutions, public entities contribute to the co-creation of a new territorial identity articulated around the past, present and the future. This new identity combines domestic values which assign importance to what was and is produced and sold locally with values related to projections of local autonomy and security of energy supply, of jobs creation as well as to a better future (quality of life) here and for society at large. Consequently, the valuation of local

renewable energy not only combines techno-productive and environmental aspects but also territorial and institutional aspects related to its generation and consumption. The latter explain how end consumers can be incited to pay more for local renewable energy.

2 The decentralization of renewable electricity production in Switzerland through the perspective of a municipal supplier

This section highlights the decentralization of production of renewable electricity production in Switzerland from the perspective of the main municipal supplier in the Canton of Neuchâtel. Such municipal utilities companies that provide electricity are iconic of the energy "transition from the bottom" in Switzerland, representative of the vast majority of the current 650 companies supplying electricity. While large companies, at regional, national or even international scale, can be vertically integrated being altogether large-scale producers of electricity generated by nuclear power plants and big dams of hydropower as well as sellers and local distributors, municipal companies are local distributors and managers of the power grid (medium and low voltage). They still benefit from a monopoly on the local energy supply market for "small" consumers while for large consumers (firms and households) the market has been liberalized since 2009[1]. These municipal companies are at the forefront of the implementation of the national energy strategy 2050. This implies to change their business model, from a fordist one based on the sale of imported energy to a new/post-fordist one based on (the increase of) the production of local renewable electricity. This change is a big deal since most of them did not have any strategy or did not adapt their business model in 2015 (EnergieSuisse, 2015).

This section highlights that the current implementation of the decentralization of electricity production is institutionally and territorially embedded. First, the Swiss energy transition is connected to a multi-scale policy framework. In this regard, the recent change related to the financing of the transition energy and decentralized production has impacted the Cantons and the Municipalities policies as well as all the actors' involved in local renewable electricity production. Second, the change of the business model of electricity suppliers is related to the construction of the local market and of the economic value of the renewable electricity.

2.1 The institutional and multi-scale context

Energy transition and the decentralization of production in Switzerland is guided by the national energy strategy 2050. On the one hand, it aims at phasing out the nuclear power by 2050, standing for 32.8% of electricity production in 2016 (Graph 1), which is associated with a significant increase of renewable electricity production (3.2% en 2016). While the potential of this increase

[1] The electricity market is liberalized for consumption over 100 MW a year.

is limited for hydropower which is quite well-developed in Switzerland, the decentralization of renewable energy is for a large share based on solar photovoltaic electricity, which goes in hand with its integration into urban built environment. On the other hand, the national energy strategy aims at reducing energy consumption. This two complementary objectives were implemented by two main funding programs since the end of 2010s, so before the coming into force of the energy strategy 2050 in 2018.

First, the «building program» launched in 2010 is related to energy efficiency measures that contributes to reduce energy consumption and carbon emission of buildings[2]. Basically, property owners of old buildings – based on various categories of old buildings – can obtain some funding if they improve the isolation of their buildings, which often goes in hand with solar cells installation. This funding comes from a third of the national carbon tax on fuel fossils paid by households and firms. While the maximum funding amount for the coming years will progressively increase from 300 to 450 millions a year, these national contributions are provided to Cantons which implement a cantonal program of energy efficiency for buildings (common framework 2015) that also includes funding[3].

Second, the promotion of renewable energy is financed by a tax on energy networks paid by all the consumers since 2009 (which has increased from 1.3 to 2.3 cents per kWh). This program has been originally based on two systems of promotion. The first system is based on an investment rationale encouraging the development of large installations for hydropower, solar photovoltaic and other kinds of energy (wind, geothermal energy) through contributions above the market price (called contribution at cost price). The second system is based on a self-consumption rationale and dedicated to small installations that were promoted by a one-time contribution. However, due to the explosion of demands for the contribution at cost price[4], which has been seen as a really good way of making money for many, it was decided to change the definition of large-scale installation. Now, only installations of a certain power – over 100 kW and 1MW for respectively solar photovoltaic and hydropower – which are in the waiting list for contribution can be included in the first system based on investment, while for the vast majority of the demands, contribution will be based on one-time compensation (unique remuneration). Moreover, the first system will be abandoned by 2023, and consequently replaced by market

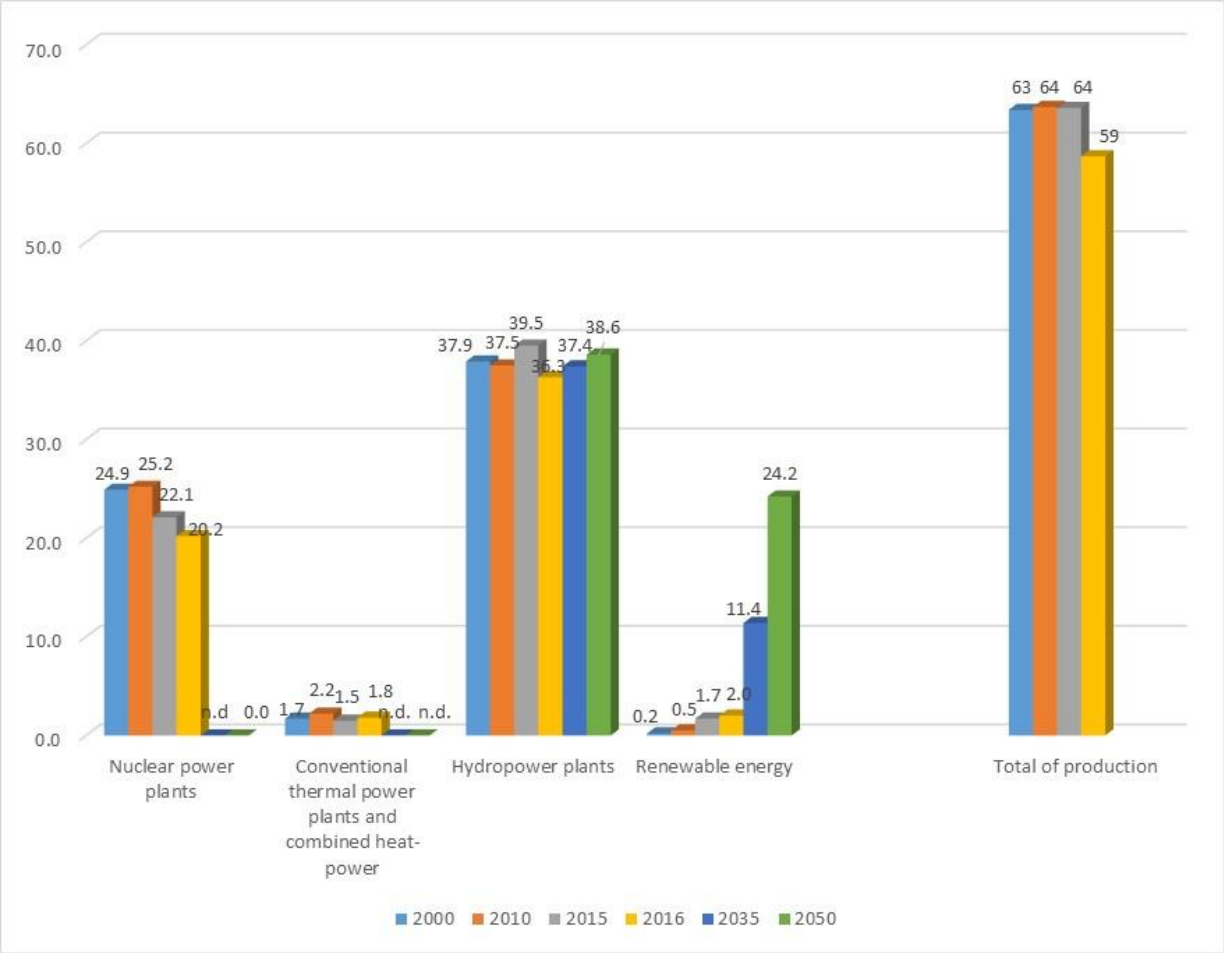
[2] Buildings' energy consumption (heating, hot water, electricity and air-conditioning) represents 40% in Switzerland.

[3] These national contributions that can cover up to 30% of the costs of work can be completed by cantonal subsidies.

[4] The system based on the contribution at cost price guaranteed for a 20 years period a price far above the market price (which could go from 25 to 40 cents a kWh depending on the size and type of electricity plants). While the contribution at cost decreased over time, the demand exploded, especially for solar photovoltaic cells: from 6000 at the end of 2009 to 39'333 in 2014 and 38'064 in 2017).

mechanism. By 2030, the decentralization of the production of renewable energy will be supported only by one-time subsidies[5].

Graph 1: the electricity production (in TWh) and the energy transition in Switzerland



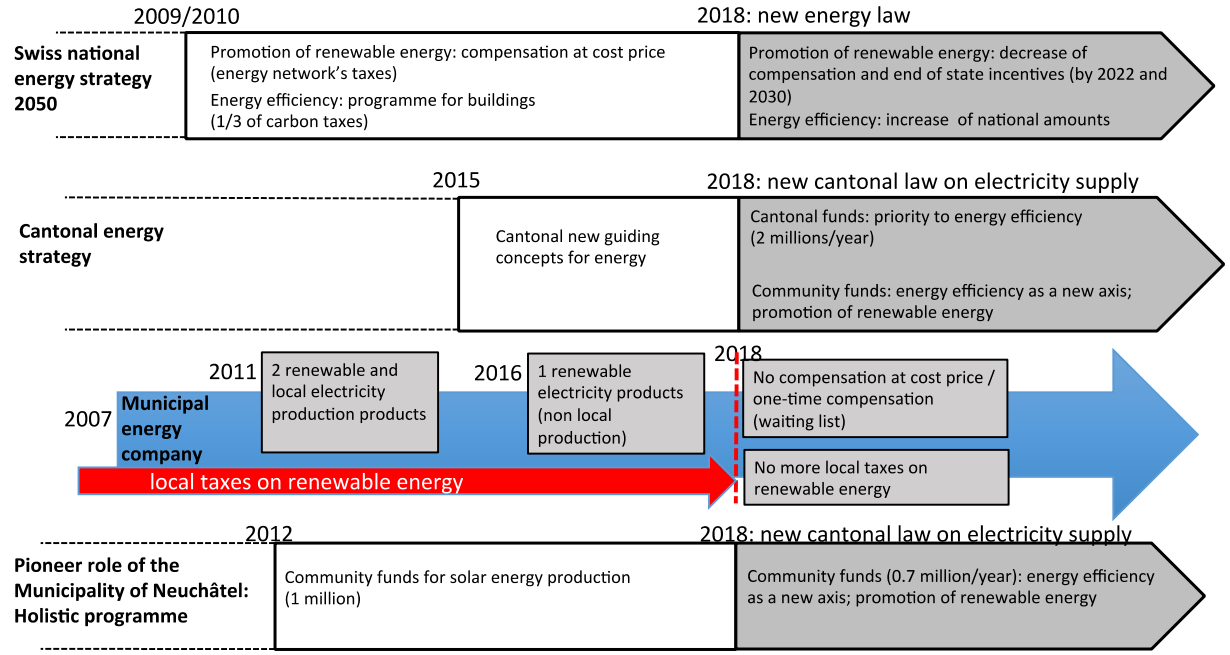
Sources : FOEN (2016) and Federal Council (2013)

Cantonal and communes energy policies are embedded in the national framework (Figure 1). Consequently, the recent change of the funding rules, namely for the decentralization of the renewable energy production, has affected the implementation of the territorialization of the energy strategy 2050. In this respect, Cantons had to adapt their regulation to the national framework, in particular to obtain the national contributions of the building program. In the case of the Canton of Neuchâtel, the cantonal law on the energy supply needed to be changed. Since

[5] One-time subsidies amount are however different for large installation (better amount) and small ones. Moreover biomass and large new hydropower installations can benefit from investment subsidies, while existing large hydropower plants can benefit from market subsidies (though very limited) until 2030.

2018, a cantonal as well as communities' funds were created to promote renewable energy and energy efficiency. They are financed by a surplus tax on energy networks which previously charged the consumers in the three main cities of the Canton and which amount was allocated to their municipal energy company.

Figure 1 : the multi-scale institutional framework of energy transition in the canton of Neuchâtel

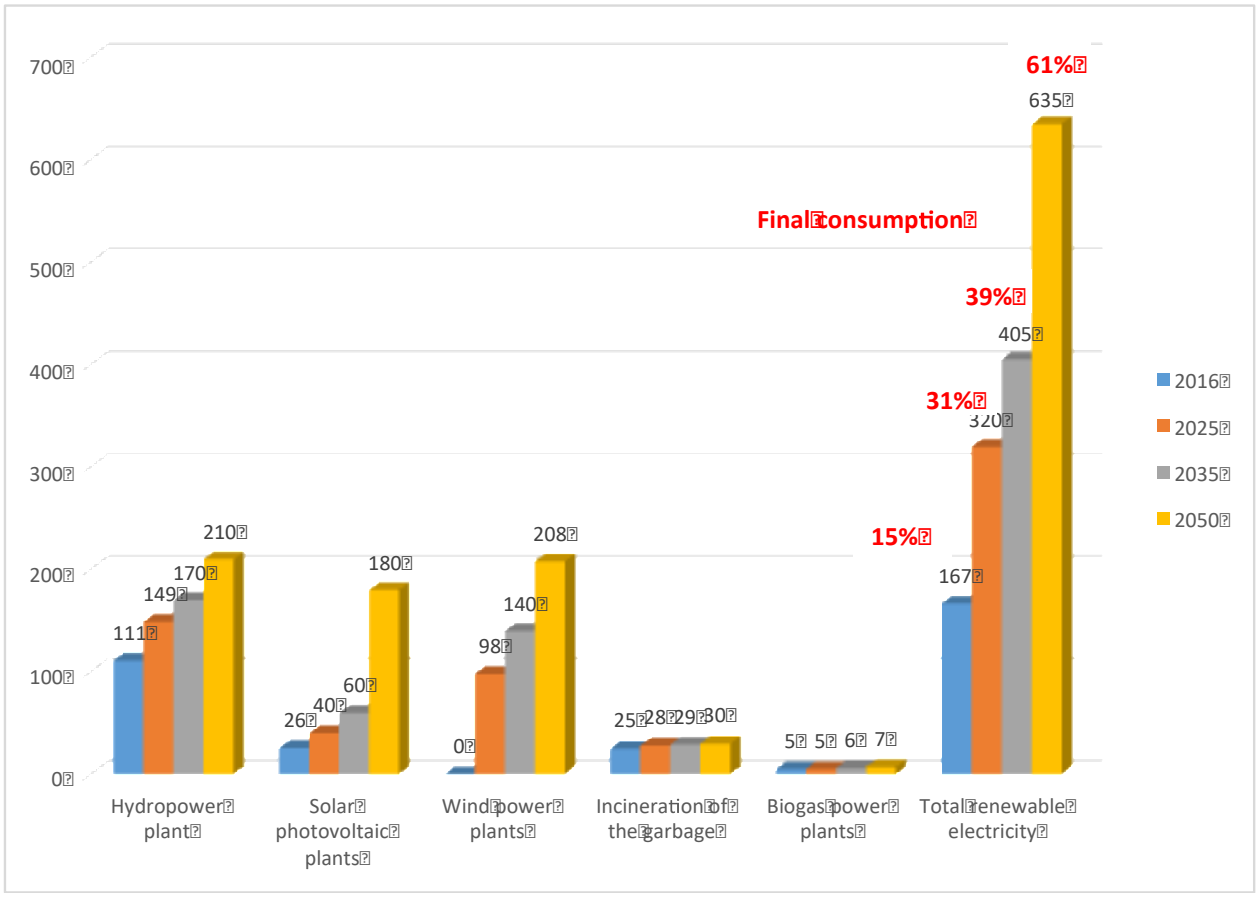


Source: own elaboration

However, priorities can be different between the Canton and the communities. At the Cantonal level, priority for the 2 millions per year fund will be given to energy efficiency to be able to use the leverage effect out of the national contributions. Thus, while the funding for the energy transition in the Canton of has just been institutionalized, the current situation seems to be very paradoxical. On the one hand, the Cantonal objectives to develop the production of renewable energy are quite ambitious (Graph 2). By 2035 and 2050, the local production is expected to reach 39% and 61% of the total consumption, while it represented 15% of the final consumption in 2016. This local potential capacity refers to three major sources, i.e. hydropower, windpower (in 2016, there was no windpower plants in the canton though) and solar photovoltaic electricity. On the other hand, the promotion of renewable energy will be either based on the national system which contributions significantly decreased or on the municipalities' policy. In the Canton of Neuchâtel, the City of Neuchâtel pioneered (also see 2.2) in the promotion of renewable electricity. The development of solar photovoltaic cells was encouraged by the creation of a municipal fund. For the coming years, this municipal promotion will be financed by the new municipal fund which result from the change of the cantonal law. However, the City of Neuchâtel

has been also using its municipal fund to encourage the isolation of buildings in the line of the national program and the energy efficiency axis.

Graph 2: the production of renewable electricity in the Canton of Neuchâtel (in GWh)



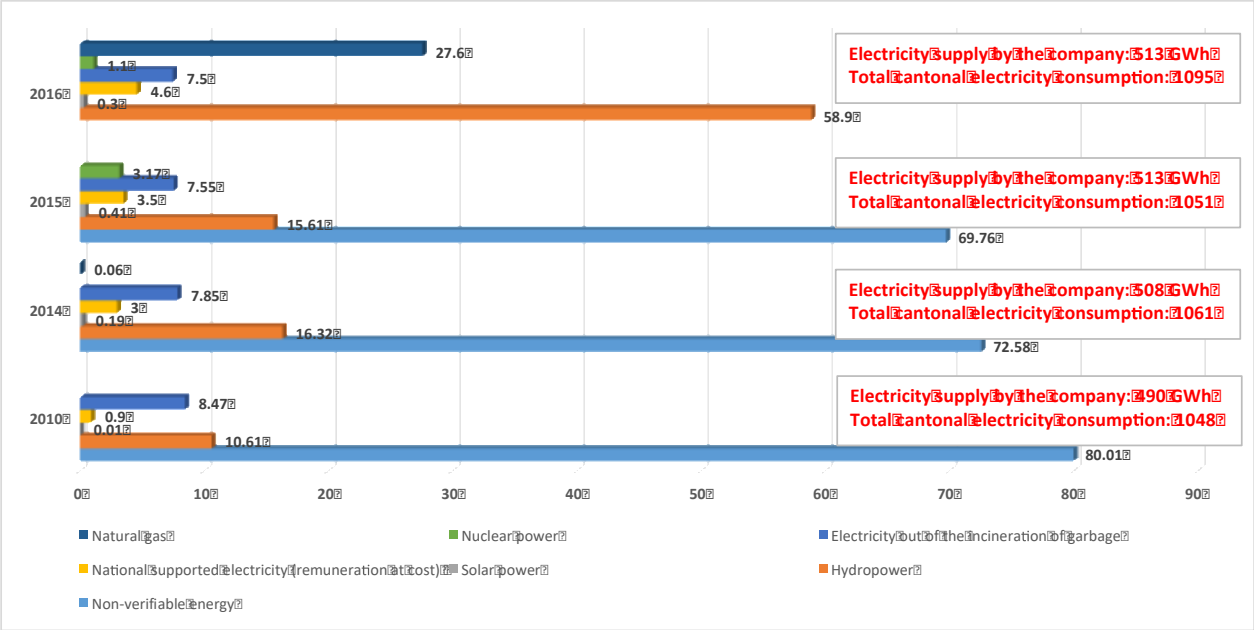
Source : Cantonal office of energy (2016) and Council of State of the Canton of Neuchâtel (2016)

2.2 The construction of the local market of renewable electricity

The main local electricity supplier in the Canton of Neuchâtel provides nearly half of the amount of the total consumption, which stands for 50'000 customers, households and firms (Graph 3). The company originates from the merging of the municipal energy companies of the three largest cities in the canton. Set up in 2007, it is a multi-energy supplier (electricity, gas, water and district heating) whose shareholders are respectively the Municipality of Neuchâtel, the Municipality of La Chaux-de-Fonds and the Municipality of Le Locle. The first subsection shows how and to what extend the territorialization of the renewable electricity has been implemented by the local supplier in the Canton of Neuchâtel. The second subsection embeds the solar

photovoltaic market strategy of the company within the local public policy and the emergence of a local valuation milieu for renewable energy.

Graph 3 : energy supply by the main local supplier (in percent)



Source: http://www.stromkennzeichnung.ch/fr/recherche.html

The territorialization of renewable electricity: the transition energy strategy of the local supplier

The energy transition strategy implemented by the local supplier s quite new. 2016 marks a turning point relative to its classic business model that was based on the sale of imported electricity. Since then, the company has changed its business model to position as a "green energy provider company" according three main areas:

1) **Importer and seller of "green electricity":** since 2016, the company first positioned as a provider of green electricity to its local customers thanks to a specific product. This latter is composed of 90% of hydropower electricity produced in Switzerland and of 10% of electricity produced out of its two local incineration of the garbage plants. Since then, this new product supplies 75% of the company's customers who agreed to pay a surplus of price for this kind of renewable energy. The creation of this new product coincides with the implementation of a full tracking of the origin of the electricity mix which is provided to customers, in accordance with the 2006 regulation. Thus, the green turn first means a change of the imported electricity mix: the previous main share made by non-tracking energy sources (more than 70%) – made up of fossil energy and partially related to the European mix – was replaced by Swiss hydropower electricity

(59%) and by natural gas (27.6%). This latter source results from the new connection to the national grid of natural gas. Furthermore, a part of this income of the product is used to finance projects related to the new company's department of energy efficiency set up in 2015 (Company, 2016).

2) **Investor and producer of local renewable electricity**: these last years, the company positioned as an investor and producer of local renewable electricity, based on two specific products. The first one is related to the local production of hydropower electricity (100%), while the second product is made up of 95% of hydropower electricity and 5% of solar photovoltaic electricity. The creation of these two products in 2011 coincides with the start of the implementation of the local production of renewable electricity.

The financing of the local production of renewable electricity is currently based on three main sources: national subsidies that relate to the promotion of renewable power plants; incomes from regional taxes on renewable energy; surplus of energy price directly payed by company costumers. However, due to the change of national and cantonal regulations implemented since 2018, these funding sources will be strongly limited.

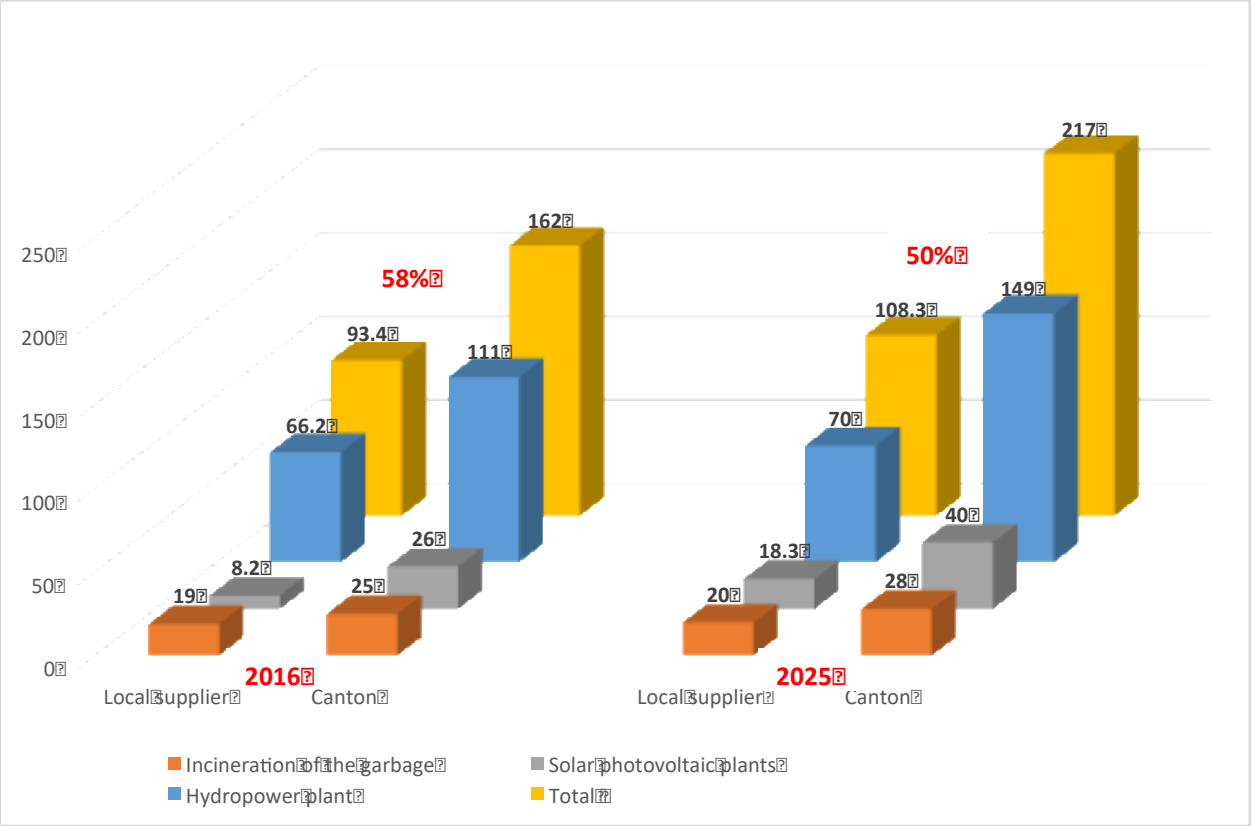
3) **Engineering consultant in energy efficiency and solar PV cells installer**: since 2016, the company intends to position in the field of energy efficiency and set up a new department accordingly. This new business which typically provides home-automation services is closely related to the national "Buildings Program" which gives subsidies to property owners for building isolation and energy consumption economies. In parallel, this department also works closely with the production department that tends now (since 2017) to provide installation and maintenance services for solar cells. Consequently, the company which has been experienced in solar cells installation as an investor, is turning to provide services especially to property owners of large buildings (such as institutional investors and other individuals) that want to invest mainly for self-consumption purposes while benefitting from the national subsidies which take the form of unique remuneration until 2030.

The local production: stagnation of the hydropower and incineration of the garbage and development of solar photovoltaic:

The development of local renewable electricity by the company relates to three types of sources such as respectively hydropower, incineration of the garbage and solar photovoltaic electricity. However, for the coming years, the company's growth in local production will be only driven by the solar photovoltaic market, which was a very new source of in-house electricity production (Graph 4).

For the two above mentioned sources of electricity production (hydropower and incineration of the garbage), the company did not plan further extension of the production during the upcoming years.

Graph 4 : Local supplier in-house production compared to the cantonal production of renewable electricity (MWh)



Sources: own calculation out of the Swiss energy website (http://www.stromkennzeichnung.ch/fr/recherche.html) and company's activity reports and website, and Cantonal office of energy (2016)

The solar photovoltaic electricity production share of the company in the canton has quite rapidly increased since 2010 up to now, from 2.1% (0.03 /1.4 GWh) to 31.5 in 2016. The company's strategy for the development of solar PV electricity covers the period 2011-2021 (Company activity report, 2015: 17). First, priority was given to large-scale solar cells (>30 kWc) in which the company is investor. Second, the local share of the company's production capacity is estimated at around 20-25% out of the 2015 cantonal guiding concepts that respectively corresponds to 8-10 GWh (40 GWh for the Canton) in 2025, and 36-45 GWh (180 GWh for the Canton) in 2050.

In short, out of the case of the main local supplier, a company representative of the many municipal companies, three main features can be emphasized about the territorialization of energy transition in Switzerland which is related to the increase of local production of renewable electricity. First, in terms of local production capacity, it shows that the "room for manoeuvre" of such local municipalities for energy transition are quite limited. In this regard, the local supplier contribution to the cantonal productive capacity has corresponded to its size, making 58% of the total so far. Due to limited hydropower capacities and the decision not to extend the electricity production out of the incineration of the garbage, the company ventured only in the new market of photovoltaic solar for which it was not experienced. Moreover, for the coming years, the company will not venture in the wind power production which potential capacity has not been exploited yet in the canton, but which would imply to find a partner both in terms of technical skills and investments. Second, it highlights that energy transition has been financed mainly by local means, and in this case by local taxes paid by consumers. Thus, the national subsidies related to renewable energy production based on quantity (remuneration by injection) has played a quite little role so far. They moreover have been replaced and drastically reduced (unique remuneration) regarding the photovoltaic solar plants. Third, the energy transition implemented from the bottom has gone in hand with a change of the municipal company's business model that has been correlated with the rationale of the multi-scale state policies that would now tend to prioritize the energy efficiency axis. Thus, the company's "green" turn is very recent and is still based on its classic core business to sell locally imported but green electricity. In parallel, the company turned to be an investor and producer in relation to the national energy transition axis. It was in a good position to venture in the photovoltaic solar production since it benefitted from the local tax system implemented by the Municipalities. While these taxes are not benefiting to the company anymore, the change of its business models to "green products" enabled it to get a new source of income to compensate, partly though, this change of the tax system. Finally, the more recent turn to the energy efficiency business must be understood in relation to the national "building program" and financial means on the one hand, and in relation to the saturation of its large-scale cells' local production. Furthermore, this turn to micro-installations market implies a decrease of its market as an energy seller since it is based on a self-consumption logic by end-users.

The role of the local valuation milieu in the city of Neuchâtel: the institutional construction of the value of local solar photovoltaic production

The photovoltaic solar production in the city of Neuchâtel has multiplied drastically these last years, going from 130 MWh in 2010 to 5245 MWh in 2017[6]. On the whole, a division of the local market can be observed. More than half of the municipal production comes from the 22

[6] In terms of quantity, the local photovoltaic solar production is still very modest. It represented 2% (4175 MWh) of the final consumption of electricity in the City of Neuchâtel (207'900 MWh).

public bodies rather large-scale installations (out of a total of 275) (**Table 2**). In this group, the 14 installations of the local supplier contributed to 41% of the total production in 2017 (2177 MWh). While the company, as an investor, has developed quite large cells, the other share of the local production comes from firms and individuals' rather small solar cells located on the roof of buildings.

Table 2: quantity of photovoltaic solar production (quantity in MWh) and number of cells by categories in the City of Neuchâtel

	Public entities		Households		Firms		Total	
	Quantity	Number of cells	Quantity	Number of cells	Quantity	Number of cells	Quantity	Number of cells
2010	100	3 (0)	30	4	0	0	130	7
2011	112	1 (1)	50	3	0	0	162	4
2012	588	4 (1)	82	8	0	0	670	12
2013	821	1 (1)	112	7	0	1	933	9
2014	821	2 (2)	586	54	135	6	1'542	62
2015	1'827	5 (4)	1'091	66	445	18	3'363	89
2016	2'240	4 (3)	1'360	28	575	9	4'175	41
2017	2'570	2 (2)	1'530	28	1'145	21	5'245	51

Source: City of Neuchâtel (given data)

The venture into the photovoltaic solar production by the company has to be embedded within the local institutional context and public policies. Over the years, a local valuation milieu (Huguenin, 2017) composed of the Municipality, local research entities and the company has emerged in the city of Neuchâtel. This milieu has played a key role in the construction of the local market by giving an economic value to the locally produced renewable energy. In this regards, two main characteristics of the territorialization of energy transition can be emphasized.

First, the construction of the local photovoltaic solar market has resulted from the convergence of two types of local public policies that had been separated for a quite long time: the linkage of the innovation policy with the urban planning and energy policy. On the one hand, the canton of Neuchâtel was a pioneer in the field of energy innovation, more specifically in the photovoltaic solar innovation in Switzerland (and even world-wide) since the mid-80s. This specialization has resulted from the creation in Neuchâtel of the CSEM[7], a research and development center related to new technologies. On the other hand, the City of Neuchâtel was one of the first cities in Switzerland to be part of the "cities of energy" which implemented in early 90s the European program HOLISTIC which objective has been to reduce the fossil energy consumption at the scale of urban districts. Since then, the urban and energy policy (legislative agenda) of the City of Neuchâtel objectives have been based on this program. However, the convergence of these two policies did not happen before 2012. Since then, the Municipality has developed an integrated energy policy which aims at both increasing the local production and improving the local

[7] CSEM stands for Swiss center of electronic and microtechnology, an institution that originates from the merging of three canton's microtechnology institutions related to the watchmaking and microtechnology industries.

competiveness which is in accordance to the national policies that promotes green innovation (Masterplan Cleantech) on the one hand, and that promotes energy transitions (energy strategy 2050) on the other hand. In this respect, the Municipality set up a one-million Swiss francs funds to promote the development of photovoltaic cells in the city's territory[8]. Since 2018, these local subsidies are financed by the local renewable energy tax which resulted from the new cantonal law on electricity supply, and which previously benefited to the local supplier.

Second, the increase of the economic value of the local solar electricity has gone in hand with the integration of new objects and new actors into the local energy policy. The local value of solar energy has first resulted from the integration of solar cells into the urban built environment. In this regard, the multiplication of (quite cheap) photovoltaic cells on the roof of buildings within a few years has made visible this issue. Following the many debates on urban landscape organized by the Municipality and gathering inhabitants, architects, energy managers, etc. architectural aspects were integrated into innovation that had been so far based on energy performance only. These last year, a department in the CSEM has been working on the energy performance in hand with the esthetic dimension of solar cells. Now solar cells can be fully integrated into the buildings – being part of the roof instead of tiles or of the building's wall. In this respect, the local supplier has been part of the emergence of the local valuation milieu. As a local state-related entity, it benefited of the local tax contributions to implement a part of the local state energy policy. This implied to change its business model and develop the local production of renewable electricity, especially the photovoltaic solar production. In this new business, the company had first to face the development of small producers and consumers promoted by the City of Neuchâtel, which impacts on the company's core business as an energy seller. Second, the company had to face the emergence of new actors such as the companies of solar cells installation. The company's strategy consisted in partnering with the CSEM, through a participation in the capital-action in 2015, and brought it skills in the energy fields while acquiring knowledge in the integration of solar cells into built environment. This partnership resulted in a first demonstrative project of a "100% Swiss made façade" located on the CSEM building in Neuchâtel which highlighted the innovative integration between energy performance and architecture. Then, this first project contributed to the multiplication of events and pilot projects in the city for which the Municipality, the company and the CSEM partnered. These demonstrative projects that highlights the esthetic function of solar cells are fully part of the increase of the economic value since the user has the possibility to incorporate the rehabilitation of its building and the energy transition.

On the whole, the state-owned local supplier has been part of this valuation milieu and benefitted from the leading role of the City of Neuchâtel. This latter has played a totally new role of the

[8] This local subsidies amount is similar to the national subsidies (unique remuneration).

implementation of local energy transition in been an intermediary between research and local market. The emergence of a local valuation milieu has been a key for the construction of the local market of the company in particular, and in general, for the way how the economic value has been constructed. In this respect, energy transition goes in re-territorialization of a banal, cheap, and fordist/centrally produced energy that has become a share and publically constructed resource which economic value is not only based on functional and productive aspects (solar cells), but on a quality which relates to new functional and esthetic aspects on the one hand (cover of façade that enables to increase the price), and on the urban landscape and innovation on the other hand (integration of the solar cells into built environment). In other words, the local valuation milieu has contributed to the creation of the economic value of local renewable energy which has implied the staging of the merging of both technical and socio-cultural aspects.

3 Conclusion

Energy transition issues are associated with the decentralization of renewable energy and thus a change of business models of local and regional energy suppliers. While these issues are related to the construction of local markets, this article embeds it into a change of paradigm that implies a new fit between the multi-scale institutional framework and the economic value of local energy. While the fordist model of energy production is vertically organized and based on the exportation of quite cheap conventional nuclear or fossil energies, the post-fordist model implies the marketization of renewable energy in a context in which it cannot compete in terms of prices. Re-territorialization is key to understanding the processes at stake in the creation of economic value and to explain how consumers can be incited to pay higher prices for renewable energy. The incorporation of global socio-cultural values such as sustainability and climate change and their translation into local context give a necessary additional economic value.

The study case shows that the change of business model of the local supplier, from distributor of imported electricity to investor and producer of renewable electricity, is embedded into a local valuation milieu composed of the Municipality, the local supplier and a research entity to re-territorializing energy. This latter “operation” combines a discourse about sustainability, energy autonomy and security, economic opportunities (creation of jobs in renewable energy) with various means that aims to make visible and tangible renewable electricity such as the organization of debates, of pilot-projects about the integration of solar cells into buildings, of events and the implementation of taxes to support local renewable energy production.

The re-territorialization of the energy market rises however various questions. First, it remains to be seen if and to what extend energy transition based on the multiplication of local markets will drive to autonomous local cities and regions, which is politically supported by arguments such as energy autonomy and security or job creations. Second, while in theory, demand associated in the

post-fordist model would be not sensitive to price, but particularly sensitive to socio-cultural values, it remains to be seen if in the case of a fully liberalized electricity market the local demand will still show a preference for local production, which typically results of the construction of loyalty (Hirschman, 1986) versus the exit enabled by liberalization.

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